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The equation of the line RS parallel to PQ and distant ω from it is:

$$y = \frac{dy_i}{dx_i}x + a^{1/3}l^{2/3} + \omega\sqrt{1 + \left(\frac{dy_i}{dx_i}\right)^2}.$$

Substituting and simplifying,

$$y = -\frac{a^{1/3}x}{[l^{2/3} - a^{2/3}]^{1/2}} + a^{1/3}l^{2/3} + \frac{wl^{1/3}}{[l^{2/3} - a^{2/3}]^{1/2}}.$$

The intersection of this line with the line $y = a$ is at $x = (l^{2/3} - a^{2/3})^{3/2} + w(l^{1/3}/a^{1/3})$, which is the required width.

Also solved by W. A. FLANAGAN and L. SIVIAN.

357. Proposed by W. D. CAIRNS, Oberlin College.

A continuous variable represented by a point on a vertical line changes according to such a law that it is reduced to $1/m$ of its value on being moved a units upward, irrespective of the special position from which it is moved. Find the law of change, that is, the relation between the variable y and the height h of the variable point above a fixed point of the vertical line.

SOLUTION BY ELIJAH SWIFT, University of Vermont.

We are to solve the functional equation $f(h + a) = (1/m)f(h)$. Taking logarithms of both sides we have the equation, $\log f(h + a) = \log f(h) - \log m$. Let $\psi(h) = \log f(h) + (h/a) \log m$. Then $\log f(h + a) = \psi(h + a) - [(h + a/a] \log m$, and $\log f(h) = \psi(h) - (h/a) \log (m)$. The above logarithmic equation becomes $\psi(h + a) = \psi(h)$, which is satisfied by any periodic function of period a. Then the function $f(h) = e^{\psi(h)-(h/a)\log m} = m^{-(h/a)} \cdot e^{\psi(h)}$ or $f(h) = m^{-(h/a)} \cdot P(h)$ where $P(h)$ is any periodic function of period a.

Also solved by JOSEPH NYBERG, J. W. CLAWSON, and the PROPOSER.

MECHANICS.

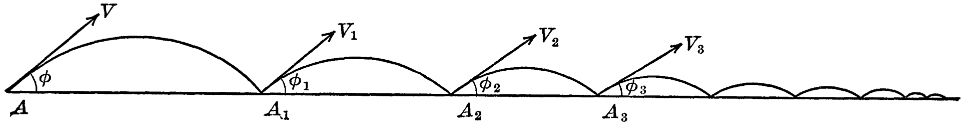
289. Proposed by C. N. SCHMALL, New York City.

A particle of elasticity e is projected with a velocity v at an angle of elevation φ from a point on a smooth horizontal plane. Show that after $\dfrac{2v \sin \varphi}{g(1 - e)}$ seconds it will cease to rebound and will move along the plane with a uniform velocity $v \cos \varphi$.

SOLUTION BY A. M. HARDING, University of Arkansas.

Let t_1 = time from A to A_1, t_2 = time from A_1 to A_2, etc. Equating the normal components before and after each impact we obtain

$$v_1 \sin \varphi_1 = ev \sin \varphi, \qquad v_2 \sin \varphi_2 = ev_1 \sin \varphi_1 = e^2v \sin \varphi,$$
$$v_3 \sin \varphi_3 = ev_2 \sin \varphi_2 = e^3v \sin \varphi, \text{ etc.} \tag{1}$$



Hence, $t_1 = (2v \sin \varphi)/g$, $t_2 = (2v_1 \sin \varphi_1)/g = (2ev \sin \varphi)/g$, $t_3 = (2v_2 \sin \varphi_2)/g = (2e^2 v \sin \varphi)/g$, etc.

$$T = t_1 + t_2 + t_3 + \cdots = \frac{2v \sin \varphi}{g}[1 + e + e^2 + e^3 + \cdots] = \frac{2v \sin \varphi}{g(1-e)}.$$

Equating tangential components before and after each impact we obtain

$$\begin{gathered} v_1 \cos \varphi_1 = v \cos \varphi, \qquad v_2 \cos \varphi_2 = v_1 \cos \varphi_1 = v \cos \varphi, \\ v_3 \cos \varphi_3 = v_2 \cos \varphi_2 = v \cos \varphi, \text{ etc.} \end{gathered} \tag{2}$$

From (1) and (2) we have

$$v_1^2 \sin 2\varphi_1 = ev^2 \sin 2\varphi, \qquad v_2^2 \sin 2\varphi_2 = e^2 v^2 \sin 2\varphi, \text{ etc.}$$

Hence Total Range $= R_1 + R_2 + R_3 + \cdots$

$$= \frac{v^2 \sin 2\varphi}{g} + \frac{v_1^2 \sin 2\varphi_1}{g} + \frac{v_2^2 \sin 2\varphi_2}{g} + \cdots$$

$$= \frac{v^2 \sin 2\varphi}{g}[1 + e + e^2 + \cdots] = \frac{v^2 \sin 2\varphi}{g(1-e)}.$$

Since the plane is smooth the particle will move with a uniform velocity $v \cos \varphi$ after it ceases to rebound.

Also solved by ELIJAH SWIFT, L. SIVIAN, CLIFFORD N. MILLS, HORACE OLSON, A. H. WILSON, and J. W. CLAWSON.

NUMBER THEORY.

195. Proposed by E. B. ESCOTT, Ann Arbor, Mich.

Find triangles whose sides are integers and one of whose angles is 60°.

II. SOLUTION OF THE GENERALIZED PROBLEM BY R. A. JOHNSON, Western Reserve University.

It is evident that there is no solution, unless the cosine of the given angle is rational. If, however, this is the case, there are always solutions. Let us assume $\cos \theta = m/n$ where m and n are relatively prime integers, such that $n > 0$, $|m| < n$.

Now if a, b, c be sides of a triangle in which θ is the angle opposite a, we have

$$b^2 - 2\frac{m}{n}bc + c^2 = a^2. \tag{1}$$

Let

$$a = b - \frac{q}{p}c \tag{2}$$

where, as is always possible, p and q have no common factor. Moreover, it is obviously sufficient to consider only *positive* values of p and q; for a case in which they would have unlike signs may be reduced to this case by a change of notation,